

MEAN REVERSION IN CORN AND HOG BASES

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Mean Reversion in Corn and Hog Bases

Once a hedge is established, the only undetermined component of the final price earned by a producer is the basis at which the hedge is lifted, assuming the hedge is maintained until the cash commodity is sold. Thus, when hedging, the ability to forecast basis behavior is instrumental to maximizing the selling price. The linkage to profit underpins a tradition of research aimed at understanding and predicting basis behavior. This tradition dates from Working's (1949) study of the storage basis for wheat and continues through the more recent econometric research which addresses the economic factors associated with the bases of various commodities (e.g., Ward and Dasse, 1977; Thompson, 1986; and Naik and Leuthold, 1991).

A second, previously unrelated body of literature has emerged concerning "mean reversion" in security and commodity markets (e.g., DeBondt and Thaler, 1985 and 1987; Fama and French, 1988 and 1989; Poterba and Summers, 1988; Cutler, Poterba, and Summers, 1991; and McQueen, 1992). In a mean reversion process, price is expected to return to its underlying (mean) value whenever market forces push the price sufficiently far from this underlying value (Poterba and Summers). A mean reversion process implies a straightforward forecast model: if current price is greater (less) than its underlying value, price is expected to decrease (increase) back toward its underlying value.

This study brings together these two bodies of literature by investigating whether mean reversion exists in the corn and hog bases. Specifically, it examines whether the deviation of the corn and hog bases from their mean value can predict subsequent movement in these bases.

No previous study has examined mean reversion in the basis, but previous research does suggest that mean reversion may exist in the basis. In particular, Working argued that the basis

not only reflected the cost of storage but also provided a strategy for deciding when to store, i.e., storage should be undertaken only when the expected change in the basis equalled or exceeded the cost of storage over the expected storage horizon. Working (1953), Heifner (1966), Martin and Hope (1984), and Tomek (1987) have shown that this strategy can increase returns to storage.

Working's strategy can be viewed as a subset of mean reversion in the basis. If the current basis differs from the expected mean basis at the end of the storage period by more than the cost of storage and mean reversion exists, then the basis should change by more than the cost of storage as it reverts back to its mean. A positive return to storage results. This mean reversion scenario parallels Working's strategy when the basis change is expected to cover the cost of storage. On the other hand, if the current basis differs from the expected mean basis at the end of the storage period by less than the cost of storage and mean reversion exists, then the basis should change by less than the cost of storage as it reverts to its mean value. A negative return to storage results. This mean reversion scenario parallels the implied consequence of Working's strategy when the basis change is not expected to cover storage costs.

If Working's strategy is a subset of mean reversion in the basis, then mean reversion may exist in nonstorable as well as storable commodities, leading to a widely applicable basis forecasting model. The methodology and data used to test for mean reversion in the corn (storable) and hog (nonstorable) bases are discussed in the next section. Analysis of the results generated by a return predictability test for mean reversion follows. Last, conclusions and implications are drawn.

Mean Reversion Forecast Model

If stochastic process X_t is mean reverting, the conditional expectation of $X_{t+1} - X_t$ at time t depends on information available at time t , specifically the distance from the mean. For example, the further price is from its mean, the greater the amount the price should change back toward the mean price. In other words, magnitude of the change in price is positively related to the distance from its mean. This hypothesis rests on the common sense notion that, if mean reversion exists, mean reversion forces should become stronger the further price is from its mean. The mean reversion forecast model can be summarized as follows:

$$(1) (P_{t+n} - P_t) = f(MP - P_t)$$

where: P_{t+n} = price at the end of the forecast period
 P_t = price at the beginning of the forecast period
 MP = mean price
 t = time

To test the predictive power of a forecast that prices revert to some fundamental value, Cutler, Poterba, and Summers (1991) suggest regressing the actual change in price over a return horizon on the deviation of price from an estimate of its fundamental value. Their regression takes the following form:

$$(2) R_t = \alpha + \beta D_t + \epsilon_t$$

where: R_t = $(P_{t+n} - P_t)$
 D_t = $(EMP_t - P_t)$
 α = intercept term
 β = slope term
 ϵ_t = error term
 EMP_t = estimate of mean price at time t
 P_{t+n} and P_t are as defined in equation 1

The β (slope) coefficient is interpreted as the fraction of the deviation from the mean price which is eliminated over the holding period (Cutler, *et al.*). A finding that β is significantly greater than zero is consistent with the existence of a mean reversion process.

Implementation of A Basis Mean Reversion Forecast Model

A mean reversion model is evaluated for corn and hog bases. These commodities are selected for analysis because they are major cash commodities in the U.S. One is considered a storable commodity (corn), while the other (hogs) is generally thought of as a nonstorable commodity. These two commodities also have liquid futures markets on which hedging can be undertaken. Thus, the existence of mean reversion in the basis would be significant to hedgers of corn and hogs.

Data

The corn basis is evaluated for three cash market locations: 1) average cash corn price paid by Ohio elevators, 2) a Champaign County Illinois elevator cash price, and 3) a St. Louis, Missouri elevator cash price. For hogs, the cash market locations are Omaha, Nebraska; Sioux City, Iowa; and Ohio direct market. This diverse set of markets provides the opportunity to determine if mean reversion in the basis is consistent across different commodities, locations, and types of markets.

The Ohio average cash corn price was obtained from the Ohio Department of Agriculture. The cash prices for Champaign County, Illinois and St Louis, Missouri were obtained from the Illinois Market News Service Sample, Illinois Department of Agriculture. The cash hog prices for Omaha and Sioux City were obtained from Iowa State University, while the cash hog prices for Ohio were obtained from the Ohio Department of Agriculture. For hogs,

the specific cash price used was the high price of the range of prices paid for U.S. grade number 1 and 2 hogs at each respective market.

Futures prices for corn and hogs are from the Chicago Board of Trade and Chicago Mercantile Exchange, respectively. These prices were collected via a computer data base available from Technical Tools, Inc.

For corn, data were available from the 1966 through 1988 crop years for Champaign County, Illinois and St Louis, Missouri. To keep the analysis consistent across all locations, data also were collected for the Ohio corn market over these crop years. For these years, the storage season was defined as starting the midweek of harvest, which was calculated as the mode week at which 50 percent of the state's corn is harvested. For Ohio, the mode week at which 50 percent of the corn is harvested is the first week of November. The comparable week for Illinois and Missouri is the last week of October. These weeks will subsequently be referred to as the date of harvest.

For Champaign County, Illinois and St Louis, Missouri, the Illinois Market News Service Sample of the Illinois Department of Agriculture provides cash price data only for Thursdays. For Ohio, Tuesday prices were collected.

For hogs, cash prices were available beginning in 1972 for the Ohio direct market. The last year cash price data were available from Iowa State is 1990. Thus, the period of analysis for hogs covered the calendar years from 1972 through 1990. Prices were collected for Friday for all three locations. In addition, cash prices were collected for Thursday for Omaha and Sioux City.

If data were missing for a futures and/or cash price, futures and cash data for the nearest available trading day were used as a replacement. However, in the case of Champaign County, Illinois and St. Louis, Missouri, missing data for Thursday translated into missing data for the week, since only Thursday cash prices are available. These weeks with missing data were deleted from the analysis.

Calculation of the Corn and Hog Bases

The basis for corn and hogs was calculated as the futures prices minus the cash price. Because the relevant holding period for hogs once they reach market weight is limited by substantial discounts for heavy hogs, the hog basis was calculated using the nearby futures contract. During the first week of the delivery month, the futures contract was rolled from the nearby to the next nearby contract. The use of the first week of the delivery month avoids erratic trading which can occur late in a delivery month. The calculation of the hog basis can be represented as follows:

$$(3) \quad B_t = (NF_t - C_t)$$

where: B_t = Basis at time t
 NF_t = Nearby futures price at time t
 C_t = Cash price at time t

The corn basis was calculated using the July futures. This futures contract was selected because it is traded over the length of the storage season, which for corn begins on September 1. This means that the returns to storage can be analyzed without the need to roll the hedge into different futures contracts.

Specifically, this basis can be represented as:

$$(4) B_t = (JF_t - C_t)$$

where: B_t = Basis at time t
 JF_t = July futures price at time t
 C_t = Cash price at time t

A component of the basis at time t is accounted for by the cost of storing the crop from time t to time t + n. This need to cover the costs of storage leads to a seasonal in cash prices for a commodity with a discontinuous harvest. To account for this expected price pattern, the basis must be calculated net of storage costs. A basis net of storage cost can be calculated as:

$$(5) NB_t = (AB_t - SC_{t,t+n})$$

where: NB_t = Net basis in \$/bushel at time t using the July futures contract
 AB_t = Actual basis in \$/bushel at time t using the July futures contract
 $SC_{t,t+n}$ = Cost of storing corn in \$/bushel between time t and time t+n
n = length of holding period

Storage Costs

Storage costs are made up of three components: physical storage cost, opportunity cost and insurance cost. Insurance costs are incurred to protect the storer from loss of grain due to fire and/or natural disaster. It is typically a very small cost and is ignored in storage cost calculations.

Physical storage costs are the costs incurred in keeping the corn in saleable condition plus the annual charge for depreciation and upkeep of the storage structure. This cost was estimated as the daily Commodity Credit Corporation (CCC) storage payment rate multiplied by the number of days in the storage period. The CCC storage payment is made to commercial elevators for storing government-owned corn. The storage payment rate is determined by CCC

based on supply and demand for commercial storage space during a given crop year. The physical storage cost incurred can be represented as:

$$(6) \text{ PS}_{t,t+n} = (\text{CR}_t / 52) * n$$

where: $\text{PS}_{t,t+n}$ = Cost incurred from physical storage from time t to time $t + n$
 CR_t = CCC yearly storage rate
 n = length of holding period

Opportunity costs arise because corn can be sold in the cash market instead of being stored. Proceeds from the cash sale can be used to pay off debt or earn interest. Opportunity costs were calculated as: the prime interest rate on the date storage was initiated multiplied by the length of the storage period times the corn cash price at the beginning of the storage period. The opportunity cost of storage can be represented as:

$$(7) \text{ OC}_{t,t+n} = C_t [1 + (\text{PR}_t / 52)]^{(n/365)}$$

where: $\text{OC}_{t,t+n}$ = Opportunity cost of storage from time t to time $t + n$
 C_t = Cash price at time t
 PR_t = Prime interest rate on an annual basis
 n = Length of holding period

The prime interest rate was collected from the Federal Reserve Bulletin, a monthly publication for the Federal Reserve System. Sensitivity of storage costs to different interest rates was tested by using the average U.S. interest rate paid on savings accounts and the rate charged by commercial banks for farm nonreal estate loans. Total storage costs varied little for the different interest rates.

Implementation of Return Predictability Test

Given the preceding discussion, the return predictability test for mean reversion in the corn basis takes the following form:

$$(8) \quad BC_t = \alpha + \beta S_t + \epsilon_t$$

where:

- C_t = $(AB_{t+n} - AB_t - SC_{t,t+n})$
- S_t = $(MB_{t+n} - AB_t - SC_{t,t+n})$
- AB_{t+n} = Actual basis in \$/bushel at time t using July futures
- AB_t = Actual basis in \$/bushel at time t+n using July futures
- MB_{t+n} = Mean basis in \$/bushel at time t+n using July futures
- $SC_{t,t+n}$ = Costs incurred in \$/bushel to store corn from time t to time t+n
- ϵ_t = error term
- n = holding period

The forecast signal is the distance from the mean, defined as S_t in equation 4. S_t equals the mean basis at time t + n minus the cost of storage between time t and t + n, based on the storage costs as of time t, minus the current basis at time t. The cost of storage in essence projects the current basis into time t + n assuming that subsequent change in the basis equals the cost of storage. Hence, this is an economic-based forecast.

The return predictability test for mean reversion in the hog basis takes the following form:

$$(9) \quad BC_t = \alpha + \beta S_t + \epsilon_t$$

where:

- BC_t = $(AB_{t+n} - AB_t)$
- S_t = $(MB_{t+n} - AB_t)$
- AB_{t+n} = Actual basis in \$/hundredweight at time t using nearby futures
- AB_t = Actual basis in \$/hundredweight at time t+n using nearby futures
- MB_{t+n} = Mean basis in \$/hundredweight at time t+n using nearby futures
- ϵ_t = error term
- n = holding period

Similar to the corn analysis, the forecast signal is the distance from the mean. However, storage costs are not included in the calculation due to the short holding periods.

Ex ante forecasts are used in this analysis. Thus, the estimate of the mean basis uses only information available at the beginning of the holding period. Specifically, the mean basis was estimated using a moving average of the bases at the end of the holding period for the previous three and five years. For example, the mean basis for the second week in February 1987 was estimated as the average of the basis for the second week in February 1982, 1983, 1984, 1985, and 1986. The use of three and five year moving averages provides a sensitivity test for the moving average estimator.

For corn, performance of the mean reversion forecasts was evaluated for one-, two-, four-, eight-, and sixteen-week holding periods. For hogs, the holding periods were one day and one week. The holding periods for hogs are limited by the small amount of time over which hogs can be marketed before they become too fat and incur substantial price discounts. In contrast, corn is a commodity which can be stored over long periods of time. A holding period of 32 weeks for corn was not analyzed to insure a sufficient number of observations.

The different holding periods allow investigation of mean reversion in the basis over different storage lengths. Previous research (Poterba and Summers) suggests that mean reversion is stronger at longer horizons.

The holding periods at two-, four-, eight-, and sixteen-weeks overlap. For example, an eight week forecast made this week and next week would overlap for seven weeks. The use of overlapping holding periods introduces serial correlation into the return predictability regression. In addition, heteroskedasticity may be present. To correct for these statistical problems the results were adjusted using the variance-covariance estimator developed by Newey and West (1987).

To analyze the consistency of mean reversion behavior over time, the full period was divided into two subperiods. For corn, the subperiods are (1) 1971 - 1979 and (2) 1980 - 1988. For hogs, the subperiods are (1) 1977 - June 1983 and (2) July 1983 - 1990. These subperiods were selected because they divide the ex-post period of analysis in half.

Testing for statistical significance of $\beta > 0$ provides evidence of return predictability. A β significantly greater than zero means that the distance from the mean is statistically related to the magnitude of change in prices.

Results of Return Predictability Tests for Mean Reversion

Corn

For the 5-year moving average estimate of mean basis over the 1971-1988 crop year sample period, all β coefficients at the one, two, four, eight, and sixteen week holding periods are greater than zero at the one percent level of statistical significance for the Ohio, Champaign County, and St. Louis markets (Tables 1, 2, and 3). These results imply the existence of return predictability for the mean reversion forecast of the storage cost-adjusted corn basis in all three markets. Statistically significant return predictability also is evident over all holding periods in all three markets when a 3-year moving average is used to estimate the mean basis.

In the return predictability regression, the β coefficient can be interpreted as the fraction of the deviation from the mean which is eliminated over the holding period. For example, the β coefficient of 0.25 for the four-week holding period in the Ohio market using a 5-year moving average means that, on average, the basis is expected to move back toward the mean by 25 cents per bushel for a 1 dollar deviation between the current basis and the mean basis. The magnitude of β increases as the length of the holding period increases in all three markets using both

moving average estimators. For example, in the Ohio market with a 5-year moving average estimate of the mean, β increases from 0.08 at one week to 0.18, 0.25, 0.31, and 0.45 over the two, four, eight, and sixteen week holding periods, respectively. This indicates that the longer the holding period, the more the storage cost-adjusted basis reverts back to its fundamental value.

The regression R^2 represents the percentage of basis movement which is explained by the model. For example, the R^2 of 0.10 for the two-week holding period in the Ohio market using a 5-year moving average indicates that mean reversion explains 10 percent of the observed basis changes over the 1971-1988 period. As with β , the regression R^2 increases with the length of the holding period.

To investigate the sensitivity of return predictability over time, the period of analysis was divided in half. The first period includes 1971 through 1979, while the second period includes 1980 through 1988. The 5-year moving average was used as the estimator of the mean in this analysis. As with the results for the entire sample period, all β 's are significant at the one percent level and increase with length of the holding period. Magnitudes of the β 's and R^2 's generally are much lower over the second subperiod than the first, suggesting mean reversion was not as good a predictor of change in the storage cost-adjusted basis during the second period.

Hogs

For the 5-year moving average estimate of the mean hog basis over the 1977-1990 sample period, β coefficients are statistically significantly different from zero at the one percent level for the Ohio, Omaha, and Sioux City markets over a one week holding period, and for the

Omaha and Sioux City markets over a one day holding period (Table 4). (For the Ohio market data are not available for the one day holding period). Significant β 's also are found for the 3-year moving average for all three markets and both holding periods analyzed. As with the results for the corn basis, this is interpreted as widespread evidence of return predictability in the hog basis.

The interpretation of the regression β 's and R^2 's is the same for the hog results as for corn. For example, the β of 0.32 in the Omaha market for the one-week holding period using a 5-year moving average indicates that, on average, the basis is expected to change back toward the mean by 32 cents per hundredweight given a 1 dollar per hundredweight deviation between current basis and mean basis over a one week period. The regression R^2 of 0.27 for the same observation indicates that 27 percent of the entire basis change for a one week period for the 1977-1990 sample is explained by the mean reversion model.

The sample period also was divided in half to test the sensitivity of the results to the time period studied. The first subperiod includes January 1977 through June 1983, and the second subperiod includes July 1983 through December 1990. The β 's for each subperiod not only are significant at the one percent level, they closely parallel the results for the entire sample period.

Conclusions and Implications

The results of the return predictability tests present widespread evidence of mean reversion in the hog and corn bases across several different markets and holding periods. The existence of a mean-reverting process is potentially very useful to hedgers of these commodities. The ability to identify and take advantage of this process provides hedgers with the opportunity

to enhance profits by making storage decisions using a mean reversion strategy to selectively hedge corn and hogs, or to lift the hedge at the most profitable time.

Given the results of this study, a useful extension of this work would be to analyze other commodities, both storable and nonstorable. In addition, analysis of mean-reverting behavior in the commodity futures and cash prices over similar holding periods would be of interest.

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Table 1. Return Predictability Test for Mean Reversion in the Corn Basis Adjusted for Storage Cost, Ohio, November 1 - July 7, 1971 - 1988 Crop Years

Moving Average Calculation of the Basis by Period of Analysis								
Holding period	5 Year Moving Average 1971-1988 ^a		5 Year Moving Average 1971-1979 ^b		5 Year Moving Average 1980-1988 ^b		3 Year Moving Average 1971-1988 ^a	
	β^c	R ²	β^c	R ²	β^c	R ²	β^c	R ²
1 Week	0.08 (6.00)**	0.05	0.22 (6.18)**	0.08	0.05 (4.16)**	0.02	0.08 (6.36)**	0.06
2 Weeks	0.18 (5.28)**	0.10	0.43 (5.91)**	0.23	0.10 (3.05)**	0.09	0.17 (5.65)**	0.12
4 Weeks	0.25 (5.82)**	0.19	0.63 (7.51)**	0.37	0.19 (3.12)**	0.12	0.27 (5.89)**	0.21
8 Weeks	0.31 (5.80)**	0.27	0.64 (8.69)**	0.46	0.22 (3.90)**	0.20	0.33 (5.73)**	0.29
16 Weeks	0.45 (6.41)**	0.42	0.78 (11.90)**	0.66	0.37 (3.94)**	0.30	0.47 (5.96)**	0.44

^{a/} Number of Observations by holding period for 1971-1988: 1 week - 630, 2 weeks - 612, 4 weeks - 576, 8 weeks - 504, and 16 weeks - 360.

^{b/} Number of Observations by holding period for 1971-1979 and 1980-1988: 1 week - 315, 2 weeks - 306, 4 weeks - 288, 8 weeks - 252, and 16 weeks - 180.

^{c/} T-ratios reported in parentheses for a one-tailed test of significance.

* Denotes significance at the 5% level.

** Denotes significance at the 1% level.

SOURCES: Chicago Board of Trade, Ohio Department of Agriculture, Original Calculations

Table 2. Return Predictability Test for Mean Reversion in the Corn Basis Adjusted for Storage Cost, Champaign County, Illinois, October 24 - July 7, 1971 - 1988 Crop Years

Holding Period	Moving Average Calculation of the Basis by Period of Analysis							
	5 Year Moving Average 1971-1988 ^a		5 Year Moving Average 1971-1979 ^b		5 Year Moving Average 1980-1988 ^c		3 Year Moving Average 1971-1988 ^a	
	β^d	R^2	β^d	R^2	β^d	R^2	β^d	R^2
1 Week	0.10 (7.42)**	0.13	0.34 (7.71)**	0.20	0.08 (4.45)**	0.06	0.14 (7.66)**	0.10
2 Weeks	0.18 (6.05)**	0.13	0.41 (5.17)**	0.25	0.12 (4.41)**	0.09	0.21 (5.72)**	0.15
4 Weeks	0.24 (5.94)**	0.19	0.51 (5.18)**	0.32	0.17 (4.15)**	0.13	0.25 (5.90)**	0.19
8 Weeks	0.26 (5.38)**	0.20	0.51 (4.61)**	0.27	0.22 (3.87)**	0.17	0.32 (5.52)**	0.27
16 Weeks	0.41 (5.53)**	0.30	0.65 (5.61)**	0.41	0.36 (3.32)**	0.24	0.42 (6.90)**	0.51

^a Number of Observations by holding period for 1971-1988: 1 week - 522, 2 weeks - 503, 4 weeks - 474, 8 weeks - 409, and 16 weeks - 304.

^{b/} Number of Observations by holding period for 1971-1979: 1 week - 239, 2 weeks - 231, 4 weeks - 215, 8 weeks - 187, and 16 weeks - 144.

^{c/} Number of Observations by holding period for 1980-1988: 1 week - 283, 2 weeks - 272, 4 weeks - 259, 8 weeks - 222, and 16 weeks - 160.

^{d/} T-ratios reported in parentheses for a one-tailed test of significance.

* Denotes significance at the 5% level.

** Denotes significance at the 1% level.

SOURCES: Chicago Board of Trade, Illinois Market News Service Sample, Illinois Department of Agriculture, Original Calculations

Table 3. Return Predictability Test for Mean Reversion in the Corn Basis Adjusted for Storage Cost, St. Louis, Missouri, October 24 - July 7, 1971 - 1988 Crop Years

Holding Period	Moving Average Calculation of the Basis by Period of Analysis							
	5 Year Moving Average 1971-1988 ^a		5 Year Moving Average 1971-1979 ^b		5 Year Moving Average 1980-1988 ^c		3 Year Moving Average 1971-1988 ^a	
	β^d	R ²	β^d	R ²	β^d	R ²	β^d	R ²
1 Week	0.05 (5.11)**	0.09	0.08 (4.51)**	0.18	0.07 (3.22)**	0.05	0.08 (5.23)**	0.06
2 Weeks	0.17 (5.64)**	0.11	0.32 (3.91)**	0.16	0.14 (4.02)**	0.09	0.17 (5.64)**	0.13
4 Weeks	0.28 (6.45)**	0.21	0.50 (5.17)**	0.32	0.24 (4.01)**	0.16	0.27 (6.43)**	0.20
8 Weeks	0.34 (6.55)**	0.25	0.52 (4.16)**	0.27	0.32 (4.42)**	0.22	0.40 (6.91)**	0.32
16 Weeks	0.45 (5.53)**	0.36	0.59 (6.19)**	0.37	0.48 (4.37)**	0.35	0.43 (7.01)**	0.52

^{a/} Number of Observations by holding period for 1971-1988: 1 week - 511, 2 weeks - 484, 4 weeks - 460, 8 weeks - 402, and 16 weeks - 298.

^{b/} Number of Observations by holding period for 1971-1979: 1 week - 239, 2 weeks - 220, 4 weeks - 206, 8 weeks - 179, and 16 weeks - 132.

^{c/} Number of Observations by holding period for 1980-1988: 1 week - 272, 2 weeks - 264, 4 weeks - 254, 8 weeks - 223, and 16 weeks - 166.

^{d/} T-ratios reported in parentheses for a one-tailed test of significance.

* Denotes significance at the 5% level.

** Denotes significance at the 1% level.

SOURCES: Chicago Board of Trade, Illinois Market News Service Sample, Illinois Department of Agriculture, Original Calculations

Table 4. Return Predictability Test for Mean Reversion in the Hog Basis, Ohio Direct Market, Omaha, and Sioux City, January 1, 1977 - December 31, 1990

Moving Average Calculation of the Basis by Period of Analysis								
Market by Holding Period	5 Year Moving Average 1977-1990 ^a		5 Year Moving Average 1977-June 1983 ^b		5 Year Moving Average July 1983-1990 ^b		3 Year Moving Average 1977-1990 ^a	
	β^c	R^2	β^c	R^2	β^c	R^2	β^c	R^2
OHIO								
1 Day	data not available		data not available		data not available		data not available	
1 Week	0.33 (15.00)**	0.29	0.33 (10.02)**	0.25	0.35 (11.71)**	0.33	0.39 (17.53)***	0.34
OMAHA								
1 Day	0.10 (6.46)**	0.05	0.13 (5.17)**	0.10	0.10 (4.80)**	0.04	0.06 (4.85)**	0.03
1 Week	0.32 (13.33)**	0.27	0.36 (8.49)**	0.27	0.32 (11.80)**	0.30	0.22 (10.22)**	0.17
SIOUX CITY								
1 Day	0.17 (5.20)**	0.12	0.11 (5.00)**	0.07	0.24 (4.60)**	0.18	0.20 (6.30)**	0.16
1 Week	0.24 (9.04)**	0.24	0.27 (6.69)**	0.19	0.23 (8.43)**	0.24	0.36 (13.45)***	0.30

^a/ Number of observations equals 676.

^b/ Number of observations equals 338.

^c/ T-ratios reported in parentheses for a one-tailed test for significance.

* Denotes significance at the 5% level.

** Denotes significance at the 1% level.

SOURCES: Chicago Mercantile Exchange, Iowa State University, Ohio Department of Agriculture, Original Calculations.

